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Climate Change Impacts and Adaptation on Pastoralists' Livelihoods: A Case of Longido District, Tanzania

Lucas Massay¹

Abstract

Pastoralism is one of the sectors most vulnerable to climate change impacts. The impact is thought to be stronger in semi-arid areas. This study aimed at assessing climate change impacts on pastoralists' livelihoods in Orkejuloongishu and Armanie villages administratively found in Longido District. Questionnaire surveys, interviews, documentary reviews, site visits and focus group discussions were used to collect data. The analysis of data employed the use of Statistical Product and Service Solutions (SPSS) 22.0 and Microsoft Excel. Findings revealed that, climate change led to tremendous decrease in number of livestock and increase of both diseases and food insecurity. As a response to the problem, some pastoralists switched to petty trade (46%), buying food (13%) and farming (9%). Both traditional and modern knowledge on climate change is very minimal. This may be attributed to low level of education, as majority (43%) of the respondents in the study area do not have formal education. As a result, adaptive strategies become more difficult, thus making their lives more vulnerable to climate change consequences. The study concludes that pastoralists' livelihoods are in great jeopardy due to change in climate. Therefore, further efforts are needed in terms of education, information flow, government and other stakeholders' involvement not only to rescue, but also in planning and implementing the strategies to adapt to climate change. The situation calls for other plans and practices to diversify climate change adaption strategies beyond those currently used by pastoralists.

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Key Words

Climate change; pastoralists;
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1.0 Introduction

Climate change is now a global issue posing challenges to the very survival of mankind and sustainable development. The adverse impacts of climate change are now evident everywhere (Paulliotte *et al.*, 2009). Climate change undermines poverty reduction efforts and threatens to undo decades of development efforts. It is widely accepted that the impacts of climate change are and will continue to be more pronounced in poor countries (Kima *et al.*, 2015)

Climate change has been defined in the Tanzanian National Plan for Action (NAPA) as variations or anomalies in the climatic components (variables) such as temperature, precipitation and greenhouse gases. The abnormal increase in one of these variables leads to alteration of weather pattern over the earth (URT, 2007). The livelihoods of pastoralist communities largely depend on livestock (Kimaro *et al.*, 2018). Pastoralism in Africa is practiced in a sensitive

¹ The University of Dodoma. E-mail: lucasmassay@gmail.com

and insecure environment; characterized by highly spatial and temporal rainfall distribution, which often results in long, dry periods (Waruru, 2011; Herrero *et al.*, 2016). Therefore, pastoralism, as an economic activity, is indeed a precarious enterprise because it depends heavily on sensitive ecological systems (World Wildlife Fund, (WWF) 2008).

Climate change has been primarily caused by selfish and shortsighted human activities such as massive industrial production and deforestation, among others (IPCC, 2014). Currently, climate change poses a threat to human development in terms of security and livelihood. Climate change and pastoralists' livelihood are interlinked processes: pastoralists and their livestock depend directly or indirectly on the environment; hence threats from climate change, particularly persistent drought, have far reaching consequences for them (Kima *et al.*, 2015). Climate change affects the availability of water resources and forage for livestock, and accelerates long periods of drought which pilots the loss of large numbers of livestock in most pastoral areas of Africa (Lemma and Ahmed, 2011; Cuni-Sanchez *et al.*, 2018).

Pastoralists face a number of challenges in today's world, but climate change and variability has suddenly risen as a leading challenge in their livelihoods (Getrude, 2010). This not only affects the quantity of livestock and their products, but it also contributes to problems on the livelihoods of the pastoralists as well as the natural resources in which they depend. The well-being of the pastoralists is always associated with the way in which their livestock perform in a given environment. However, climate is considered an important factor that influences pastoralists' livelihoods (Bryan *et al.*, 2013). The way of life that has supported them for thousands of years is falling prey to the impact of climate change and it is estimated that close to one million people have already been forced to abandon pastoralism (Opiyo *et al.*, 2015; Cuni-Sanchez *et al.*, 2018). However, impacts of climate change are expected to pose more stress to the livelihoods of the developing countries due to their exposure and sensitivity to climate related extremes. This is due to the fact that they have limited capacity to adapt and deal with such effects and hazardous events; hence becoming more vulnerable to damages associated with climate change (Nkuba *et al.*, 2019).

Furthermore, information on climate risks is vital to shape actions against climate change impacts (Zumsteeg 2012; Nkuba *et al.*, 2019). In addition, the way that pastoralists perceive the risk of climate change strongly influences how they deal with the climate's adverse impacts (Adger *et al.*, 2009; Patt and Schröter 2007). Similarly, misconception about climate change and its associated risks may result in maladaptation or no adaptation at all, thus increasing the negative impacts of climate change (Grothmann and Patt 2005). Establishment of climate change perception and its impacts in pastoral communities is critical to inform decision makers and planners to take appropriate actions that will enhance pastoralists' capacity and adaptation to climate change (Debela *et al.*, 2013; Juana *et al.*, 2013). Maasai communities

in northern Tanzania are increasingly faced with a number of challenges related to (among other things) loss of land ownership due to establishment of new conservation and administrative areas and also increase of agricultural activities to meet their increasing food demands (Galvin *et al.*, 2001; Galvin *et al.*, 2004; Msoffe *et al.*, 2011; Kimaro *et al.*, 2018). Global climate change is a significant additional stress to these communities. There is a limited understanding of how climate change and variability affects livelihoods of the pastoralists' communities and how they cope with the situation.

Some studies in the study area have focused on socio-economic vulnerability of Maasai pastoralists (Theodory and Malipula 2013) or on effects of the 2009 drought on cattle mortality and associated response by pastoralists (Goldman and Riosmena 2013). Climate change studies focusing over a long period of time are critical for better assessment of climate change (IPCC 2007). Twenty or thirty-year time frame of assessment has been adopted for other studies (Deressa *et al.*, 2011; Osbahr *et al.*, 2011; Dinku 2018). This study, therefore, seeks to address the gap in knowledge on climate change and variability impacts on pastoralists for Longido District. Additionally, the study focused on the following objectives: To assess pastoralists awareness on climate change impacts, to assess impacts of climate change on pastoralists' livelihoods, to identify constraints faced by pastoralists in overcoming the problem and finally to find out the strategies used to overcome the problem.

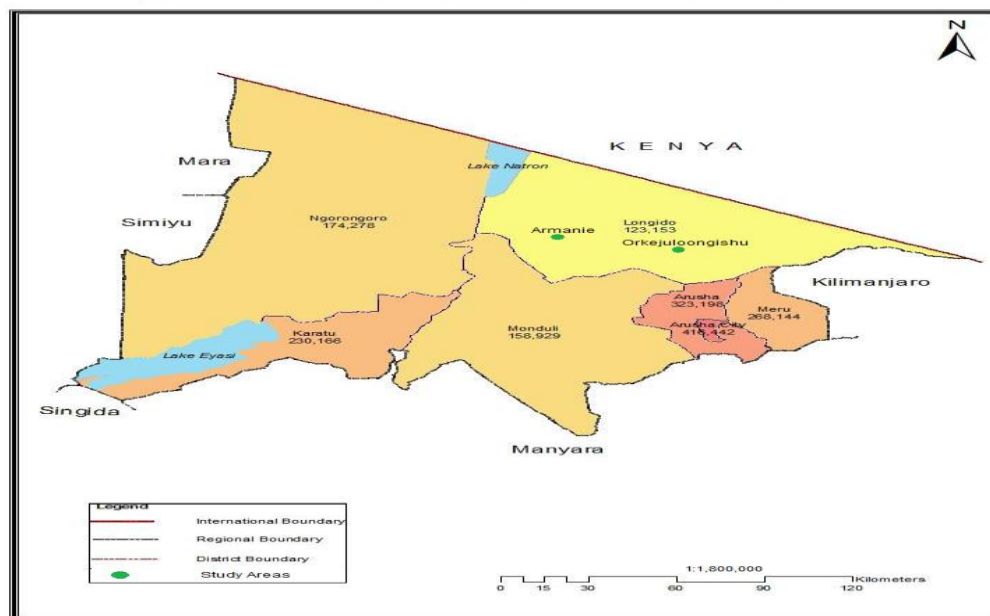
2.0 Materials and Methods

2.1 Study Area

Longido District was selected for this study based on the following criteria (i) homeland to pastoralist communities that depend largely on livestock for their livelihood (ADF 2003) and (ii) comprised of mostly arid/semi-arid lands that have experienced severe climate variability including increasing drought periods and unpredictable rainfall (Theodory and Malipula 2013). A list of all pastoralist villages in the lowland ecological zone was obtained from the Livestock Department of Longido District, and two villages were randomly selected for this study. Households were randomly selected from the sampling frame obtained from the village executive officers. Before the study, the research team visited the selected villages for formal introduction of the project.

Orkejuloongishu and Armanie villages are located in the north eastern part of Tanzania and to the west of the City of Arusha. The two villages are found in Longido District, which was established in 2007. Longido District was part of Monduli District before 2007. It is bordered by Kenya in the East, Ngorongoro in the West and Kilimanjaro Region in the South. The villages are positioned between 2°47' to 2°57'S and 36°37' to 36°41'. Both villages are hilly in their northern fringes and open plains towards Kenyan border.

The two villages are characterized by bimodal type of rainfall pattern comprising of short rains happening in November to December and long rains taking place in March to May. These rains are very unpredictable. Months of June and July mark the cold months of the year with temperatures going down to 13° C. October and November mark the hottest months of the year with temperature as high as 30° C. The area, being semi-arid receives a maximum of 500mm of rains per year in rainy seasons. These periods occur when the Intertropical Convergence Zone (ITCZ) is located approximately over the equator, also contemporaneous with times of average monthly temperature maxima (Theodory and Malipula 2013). The livestock kept in the study areas include cattle, goats, sheep and donkeys.



Map Showing the Location of the Study Area

Source: Longido District Council Library

2.2 Data Collection and analysis

Different methods of data collection were used in this study; these included the use of questionnaires, interviews, observation, focus group discussion and documentary review. While the first three methods were employed to get primary data, the last one was useful in getting secondary data.

The researcher conducted questionnaire pretesting to ten (10) local residents who were picked randomly and informally. Finally, questionnaires were administered face to face on household respondents since it provides a room for accurate screening, it captures nonverbal clues keeps focus on objectives

and it controls respondents' emotions and behaviour during the process. However, the researcher carried out interviews in both villages.

Interviews that lasted between eight (8) to twelve (12) minutes were conducted amongst two (2) village executive officers, four (4) traditional leaders/elders, four (4) community development officers, three (3) NGOs official working in the study areas, and three (3) ward livestock officers. The interviews were useful in collecting information directly from knowledgeable and specialists in climate and variability. The interviews were conducted in both Swahili and Maasai languages. Research assistants translated Swahili to Maasai language and vice-versa to facilitate smooth understanding of the subject under investigation.

Additionally, the total of eight (8) FDGs were conducted which comprised of two (2) elderly men, two (2) elderly women, two (2) youth males and two (2) youth females aged 30 to 39. On the whole the study comprised of six (6) participants for each FGD. The criteria for selection based on the member's experiences on observing climate variability and change in the study villages. The choice of eight (8) members per group was enough for this study and it was within the recommended range of 5 to 15 members per group (Gaizauskaite, 2012). The time per FGD was 45 minutes to one (1) hour.

The analysis of data employed the use of Statistical Product and Service Solutions (SPSS) 22.0 and Microsoft Excel. This efficiently and accurately helped in the process and enabled further analysis of data collected through questionnaires preceded by data editing and coding. On the other hand, the collected data from interviews were mainly qualitative in nature. As pointed out by several social scientist researchers, qualitative data analysis has no one right way to proceed with analysis (Kombo and Tromp, 2006). So, the researcher recorded the key issues of the interviews, such as impacts of climate change, mitigation measures used and suggestions; and summarized those key findings and provided explanation of the findings.

3.0 Results and discussion

3.1 Socio-economic profile of the respondents

The socio-economic characteristics of the population sample of the surveyed villages are presented in Table 1 below. Examining social economic characteristics of the respondents was crucial because of enriching triangulation of data in survey meaning that respondents had varied perceptions on climate change impacts on their livelihoods. Population of males was higher (69%) compared to that of females (31%) from both villages. As for the age of respondents, 57% of the respondents were between 35 to 54 years of age. 43% of the respondents had informal education. As for household size about 48% of the respondents had the household of between 11 to 15 members. According to DFID (2018), the size of the pastoralists' household determines the level of human capital, which is a factor of amount and quality of labour available.

Hence, the number of household members is very crucial in carrying out different chores basing on the age and sex set. In addition, the gravity of the impact of climate change on a household would be determined by the number of its victims.

The finding about the education level of the informants is not far from the study done by Mng'ong'o and Mwamfupe 2013; Kimaro *et al.*, 2018, which indicated that majority of Maasai pastoralists lack formal education. This means that level of illiteracy in the area is still high, which may have impact on educating the pastoralists' community. It may be worth noting that Huho (2011) considered level of education of the respondents would determine the consistence of the perceptions on climate change and adaptation practices.

Table 1: Socio-economic Profile of the Respondents

Characteristic of variable	Villages		Av.
	Orkejuloongishu (n=61)	Armanie (n=39)	
	%	%	%
Gender			
Male	70	68	69
Female	30	32	31
Age			
18-34	23	27	25
35-54	61	53	57
54>	16	20	18
Education			
Informal Education	47	39	43
Primary Education	32	42	37
Secondary Education	20	17	18.5
Tertiary Education	1	2	1.5
Occupation			
Livestock Keeper	70.4	64.1	67.3

Farmer	8.2	7.7	8
Teacher	5	5.1	5.1
Businessperson	16.4	15.4	15.9
Unemployed	0	6.7	6.7
Number of household members			
1-5	24.5	15.4	20
6-10	16.4	20.5	18.5
11-15	49.2	48.7	49
16 and above	8.2	5.1	6.7
None	1.6	10.3	6

3.2 Awareness on climate change

Respondents were asked if they have experienced climate changes in their area. Their responses were limited to Yes or No. Overall, the majority 78.9% of the respondents were aware that climate change is taking place (see table 2).

Table 2: Respondents Response on the Existence of Climate Change Frequency

Response	Villages		Av.
Existence of climate change	Orkejuloongis hu (N=61)	Armanie (N=39)	
	%	%	%
Yes	73.7	79.5	78.9
No	14.8	5.1	9
Don't know	11.5	15.4	12.1
TOTAL	100	100	100

Source: Field data N=Sample size

During focus group discussion, one discussant (a 50 year old man) had this to say on climate change:

For the last four years, we have been experiencing drought. I had 83 cows but now I have remained with only five, we used to depend on milk and blood from cows for food but now we are starving.

Respondents were probed to mention some indicators of climate change. Indicators in order of preference were; change in rain season (unpredictable rainfall) 37.4%, drought 33.9%, and reduced pasture 19.3% and livestock diseases 10% (See Table 3).

Table 3: Indicators of Climate Change

Indicators	Villages		Av.
	Orkejuloongishu (N=61)	Armaniye (N=39)	
	%	%	%
Change in rain season	32.8	41.9	37
Drought	34.4	33.3	33.9
Reduced pasture	18	20.5	19.1
Livestock diseases	14.8	5.1	10
TOTAL	100	100	100

Source: Field Data, N=Sample size

These results imply that rainfall trend has changed; meaning that the beginning and the end of both short and long rains are no longer the same. Additionally, the drought experienced today is more uncommon compared to years back. According to Kimaro *et al.*, 2018, it is estimated that on average Arid and Semi-Arid Lands (ASALs) households in Longido lost 65% of cattle and 33% of sheep and goats to drought in 2009 which was judged as severe.

3.3 Impacts on pastoralists livelihoods

Respondents were asked to mention the impacts of climate change. Results (See Table 4) indicate that death of livestock 41% and 35.9% is the main impact of climate change. TRIAS (2018) argues that population of cattle has

dropped from 12,122 before 2009 drought to 1,432 after 2009 drought in Orkejuloongishu. On top of that, hunger was mentioned by 32.8% and 25.6% respectively from both villages as the second major impact of climate change on pastoralists. As a result, the government had to provide 11,487.50 tons of maize to the families affected by climate change (Longido District report, 2012). This implies that pastoralists get much of their food from livestock and livestock products which means, the impacts posed by climate change on livestock has a direct impact on food availability to pastoralists.

Table 4: Main impacts of climate change

Impact	Villages		Av.
	Orkejuloongishu (N=61)	Armanie (N=39)	
	%	%	%
Death of livestock	41	35.9	38.5
Hunger	32.8	25.6	29.2
Loss of income	16.4	15.4	15.9
Family disintegration	4.9	10.3	7.6
Rural-urban migration	4.9	12.8	8.85
TOTAL	100	100	100

Source: Field data, N=Sample size

Thus, as the findings suggest (See Figure 1), 64% and 71% of the respondents felt that one of the major effects of climate change on their livelihoods is the death of cattle. This is due to the fact that pastoralists derive main part of their livelihoods from livestock; hence any disturbance to the welfare of the livestock affects the livelihoods of the pastoralists. On the other hand, 16.4% and 10.3% of the respondents considered loss of income as a major effect. Also, the study by Huho *et al.* 2011; Kimaro *et al.*, 2018 has shown that in 2009, 70% - 90% livestock were lost due to climate change in Kenya and Tanzania. Death of livestock implies a lost income and asset.

Hunger was cited by 19.6% and 18% of the pastoralists, as one of the effects on their livelihoods. Livestock is one of the principle drivers of the pastoralists' livelihoods and any negative impact on the livestock means costing pastoralists livelihoods. One of the participants during focus group discussion said that:

I lost almost all of my livestock. I now want to go to town to look for casual labor so that I can provide food for my children as they are now starving since they drink only porridge in the morning.



Figure 1 Livelihoods options hit hard by climate change

As for the impacts on livestock production (See Table 5), it was observed that overall 74.4% of the respondents mentioned that livestock production is very severely affected by climate change as they are all depending on livestock for their survival. This implies that, pastoralists whose lives are highly dependent on livestock and livestock products will still be victims of climate change impacts. According to Lemma and Ahmed 2011; Kihila 2018; Sewando *et al.*, 2016 favorable condition for ticks, snails, blood-sucking insects and pests outbreaks backed up by climate change have reduced milk and meat production in parts of northern Tanzania and Southern Kenya.

Table 5: Severity of climate change impacts on livestock production

Rank	Villages		Av.
	Orkejuloongishu (N=61)	Armanie (N=39)	
	%	%	%
Very severely	78.7	69.2	74.4
Severely	9.8	17.9	13.9
Moderate	6.6	12	9.3
Low	4.9	0	2.4
TOTAL	100	100	100

Source: Field data, N=Sample size

Respondents were asked to air out their views on the trend of livestock production. They were limited to four options which are increasing, declining, stable and don't know. Results (See Table 6) show that majority of the respondents 80.3% and 74.4% said that, the number of livestock between 2009 and 2019 has been declining with 2009 cited by the highest number of respondents as the year of sudden decline. According to Longido District Report (2011), the number of cattle in four villages namely Orkejuloongishu, GelaiMeiguroi, Noondoto and GelaiLumbwa has declined from 24,459 before 2009 drought to 7,643 after 2009 drought. These results imply that pastoralists have no control on this sudden decrease on the number of their livestock which exposes them more to other problems such as hunger and diseases.

Table 6: Percentage of livestock trend in the study areas

Response	Village		Av.
	Orkejuloongishu (N=61)	Armanie (N=39)	
	%	%	%
Declining	80.3	74.4	77.35
Don't know	13.2	17.9	15.55
Stable	6.5	5.1	5.8
Increasing	0	2.6	1.3
Total	100	100	100

Source: Field data. N=Sample size

3.5 Strategies used to adapt to the impacts of climate change

From this study results (See Figure 2), it is revealed that most of the respondents 60.6% (n=61) and 71.9% (n=39) mentioned mobility as a major strategy used by pastoralists in adapting to climate change. The implication from the results is that most of the pastoralists opted to move from place to place in search for an area with lesser climatic impact. Mobility was also identified by Brocklesby *et al.* (2010) as pastoralists' necessary part of competence and sign of livelihood security.

One of the interviewees in this study said that: "We opt to move with our livestock to better areas (climatically less affected areas) because this is the best option to save our livestock and thus ensure our livelihoods."

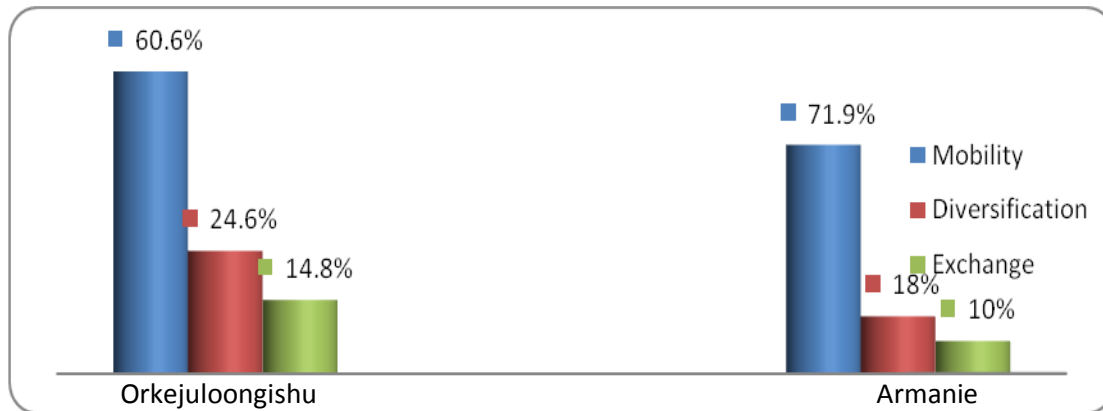


Figure 2 Strategies used to adapt to climate change

Source: Field data

As can be seen in Table 7, pastoralists have many methods to meet their livelihoods during climatic problem, though the methods are of different levels. Petty trade was mentioned by 42.6% (n=61) and 51.3% (n=39) of the participants respectively as one of the mechanisms to ensure sustainable livelihoods, while selling livestock was mentioned by 29.6% (n=61) and 30.8% (n=39) in both villages. From the views of some respondents, Maasai pastoralists sell part of their livestock when these livestock are in real critical conditions such as when they fall sick, become very thin or old. For them, selling livestock is not the priority; instead they would rather prefer to buy more in order to increase the number of their livestock.

From the interviews conducted with the Ward Livestock Officer and Village Executive Officers, it was discovered that Maasai pastoralists would not sell their cattle just only when they are in dire need of money. The ward executive officer said: “For a Maasai livestock is wealth and pride. He further said that no one can sell his pride in the Maasai community.” This is due to the fact that they highly value livestock as a symbol of their social pride and status.

Table 7: Mechanisms used to ensure sustainable livelihoods

Mechanism	Villages		Av.
	Orkejuloongishu (N=61)	Armanie (N=39)	
	%	%	%
Petty Trade	42.6	51.3	46.95
Selling livestock	29.6	30.8	30.2
Buying food	18	10.3	14.15
Farming	9.8	7.6	8.7
TOTAL	100	100	100

Source: Field Data. N=Sample size

4.0 Conclusion

In assessing climate change impacts on pastoralists' livelihoods, further efforts are needed in terms of education, information flow, Government and other stakeholders' involvement not only to rescue, but also to plan and implement the strategies to overcome climate change. Despite the constraints faced by the pastoralists in overcoming climate change, this study revealed that there were at least positive aspects towards diversification of livelihoods in the course of overcoming climate change. Thus local observations on climate change should be considered and integrated with scientific knowledge in order to form clear climate change adaptation strategies and policies. Improvement on climate information and early warning systems in pastoral communities is a vital component for building pastoralist resilience, but is currently lacking in Longido District. Detailed long-term scientific research is needed to quantify and verify the reliability and relevancy of indigenous knowledge in forecasting weather patterns. This study informs policy makers and animal health planners on development of appropriate measures including stable institutional support for adaptation and mitigation practices in pastoral communities. Additionally, on the basis of this study, I recommend establishment of structured climate change information and early warning systems to better support these vulnerable communities. These plans can be achieved through multidisciplinary approaches involving the Tanzania Meteorological Agency (TMA), climatologists, ecologists, epidemiologists, local government and animal health development partners working together through NGOs, civil society and community-based organizations to equip and to enhance the resilience of pastoralists' communities against climate change impacts.

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